



**FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8**

**CLASS II PERMISSIVE CHANGE
TEST REPORT**

FOR

**802.11a/g/n WLAN + Bluetooth PCI-E Custom Combination Card
(Tested inside of MacBook Pro. model A1398)**

MODEL NUMBER: BCM94331CSAX

**FCC ID: QDS-BRCM1062
IC: 4324A-BRCM1062**

REPORT NUMBER: 12U14283-3, Revision A

ISSUE DATE: MAY 21, 2012

Prepared for
**BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, U.S.A**

Prepared by
**COMPLIANCE CERTIFICATION SERVICES (UL CCS)
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888**



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	04/10/12	Initial Issue	F. Ibrahim
A	05/21/12	Updated client address	A. Zaffar

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, U.S.A

EUT DESCRIPTION: 802.11a/g/n WLAN + Bluetooth PCI-E Custom Combination Card (Tested inside of MacBook Pro. model A1398)

MODEL: BCM94331CSAX

SERIAL NUMBER: B1-120608

DATE TESTED: APRIL 5-9, 2012

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By:

Tested By:



FRANK IBRAHIM
EMC SUPERVISOR
UL CCS

TOM CHEN
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a 802.11a/g/n WLAN + Bluetooth PCI-E Custom Combination Card (Tested inside of MacBook Pro. model A1398).

The radio module is manufactured by Broadcom.

5.2. DESCRIPTION OF CLASS II CHANGE

Different antennas with different gains were used and the radio module was installed inside a specific host laptop PC.

5.3. MAXIMUM OUTPUT POWER

Power was measured and found to match the original power values within +/- 0.5 dB. Please refer to original report "11U14154-16A FCC BLUETOOTH FHSS.doc" for output power.

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

No.	Antenna Manufacturer	Antenna Type	Model	Peak gain 2402 to 2484Mhz dBi	Peak gain 5150 to 5250MHz dBi	Peak gain 5250 to 5350MHz dBi	Peak gain 5470 to 5725MHz dBi	Peak gain 5725 to 5850MHz dBi
1	Amphenol	802.11abgn WLAN Antenna		0.12	7.04	7.09	5.03	2.66
2	Amphenol	802.11abgn WLAN/BT Antenna		5.30	6.70	7.06	6.66	5.93
3	Amphenol	802.11abgn WLAN Antenna		4.69	3.79	3.58	3.94	6.04
total (mW)				7.36	12.13	12.48	10.30	9.78
Composite 3x3 CDD mode testing for FCC/NCC ONLY dBi				8.6687781	10.838219	10.961713	10.126723	9.903389
No.	Antenna Manufacturer	Antenna Type	Model	Peak gain 2402 to 2484Mhz dBi	Peak gain 5150 to 5250MHz dBi	Peak gain 5250 to 5350MHz dBi	Peak gain 5470 to 5725MHz dBi	Peak gain 5725 to 5850MHz dBi
1	Molex	802.11abgn WLAN Antenna		-0.79	5.87	5.12	4.16	3.21
2	Molex	802.11abgn WLAN/BT Antenna		4.67	6.60	6.46	6.25	5.41
3	Molex	802.11abgn WLAN Antenna		2.92	4.15	4.32	4.31	4.06
total (mW)				5.72	11.03	10.38	9.52	8.12
Composite 3x3 CDD mode testing for FCC/NCC ONLY dBi				7.5765555	10.42761	10.162273	9.7867609	9.093583

5.5. SOFTWARE AND FIRMWARE

The firmware installed on the EUT was V66C4494

The test utility software used during testing was 4.0.6.f11

5.6. WORST-CASE CONFIGURATION AND MODE

For radiated emissions below 1 GHz and power line conducted emission, the channel with highest output power was used as worst-case scenario.

This is desktop device; therefore, it was tested with EUT laid out as desktop unit.

5.7. DESCRIPTION OF TEST SETUP

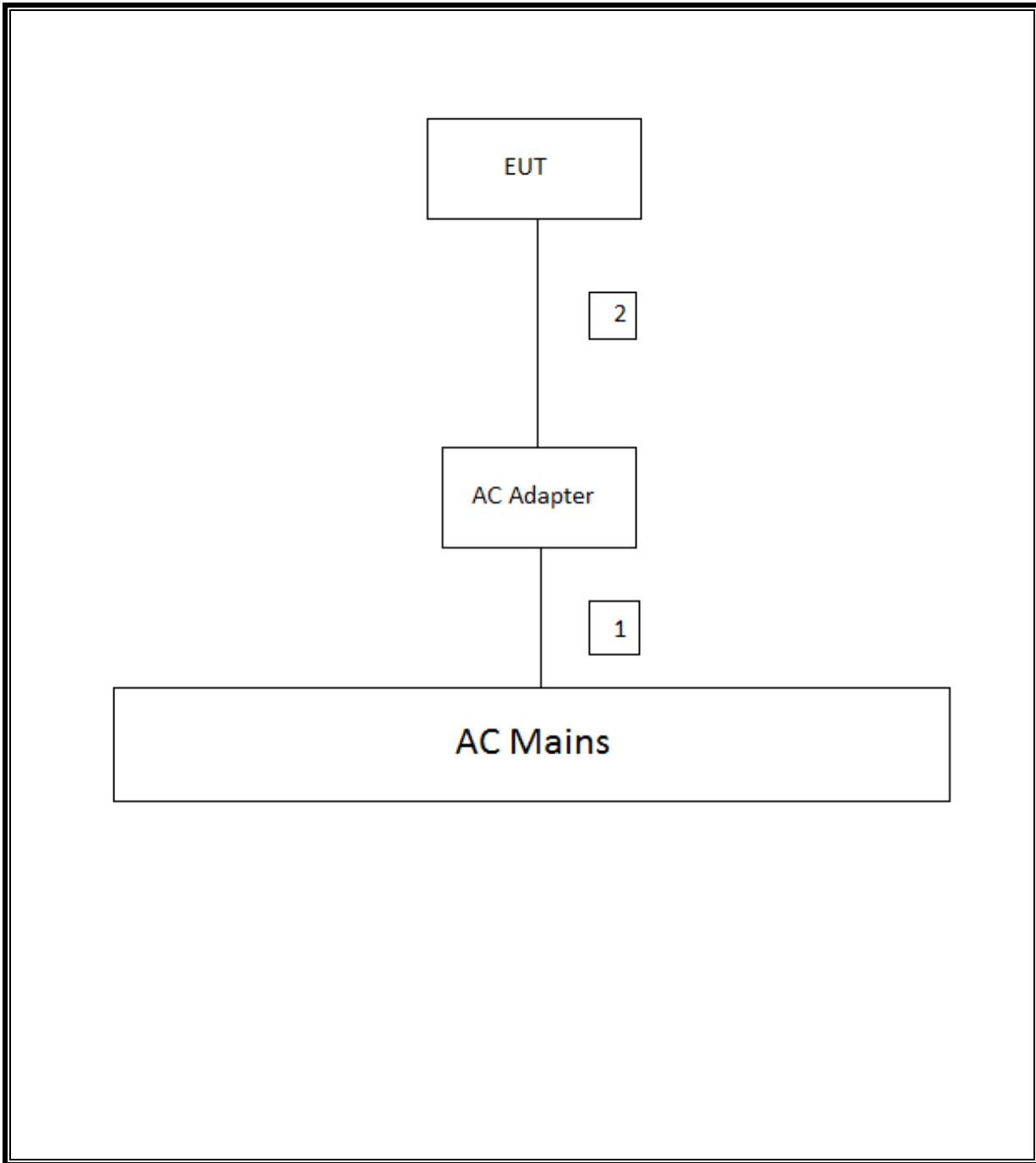
SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Adapter	Apple	ADP-85FB TA	C04203404B6DT9PHN	DoC

I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	1.5m	N/A
2	DC	1	DC	Un-shielded	1.5m	N/A

SETUP DIAGRAM FOR TESTS



Note: laptop PC was used to control the operation of the EUT.

6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/14/12
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06/29/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	11/11/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	07/12/12
Horn Antenna, 26.5 GHz	ARA	MWH-1826/B	C00589	07/28/12
Horn Antenna, 40 GHz	ARA	MWH-2640/B	C00981	06/14/12
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	03/14/13
Reject Filter, 2.0-2.9 GHz	Micro-Tronics	BRM50702	N02684	CNR
High Pass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01159	05/11/12
Peak Power Meter	Agilent	N1911A	1260847C	08/04/12
Peak Power Sensor	Agilent	E9323A	1244073F	08/04/12
Reject Filter, 5.725-5.825 GHz	Micro-Tronics	BRC13192	N02676	CNR
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
EMI Test Receiver, 30MHz	R & S	ESHS 20	N02396	08/19/13
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	12/13/12

7. ANTENNA PORT TEST RESULTS

For antenna port test results, please refer to the original report "11U14154-16A FCC BLUETOOTH FHSS".

8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

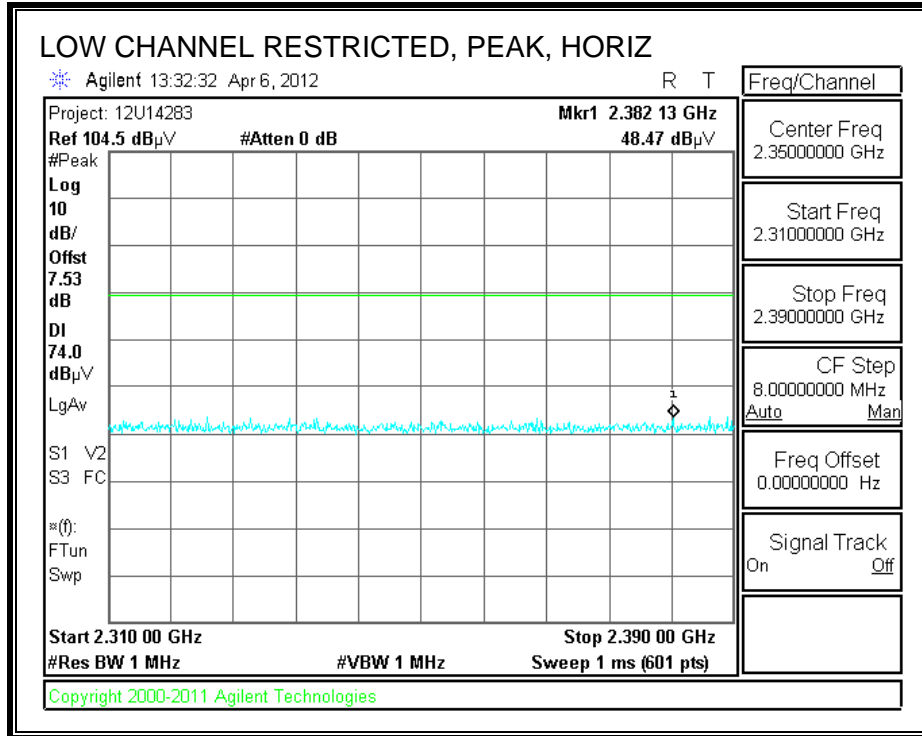
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

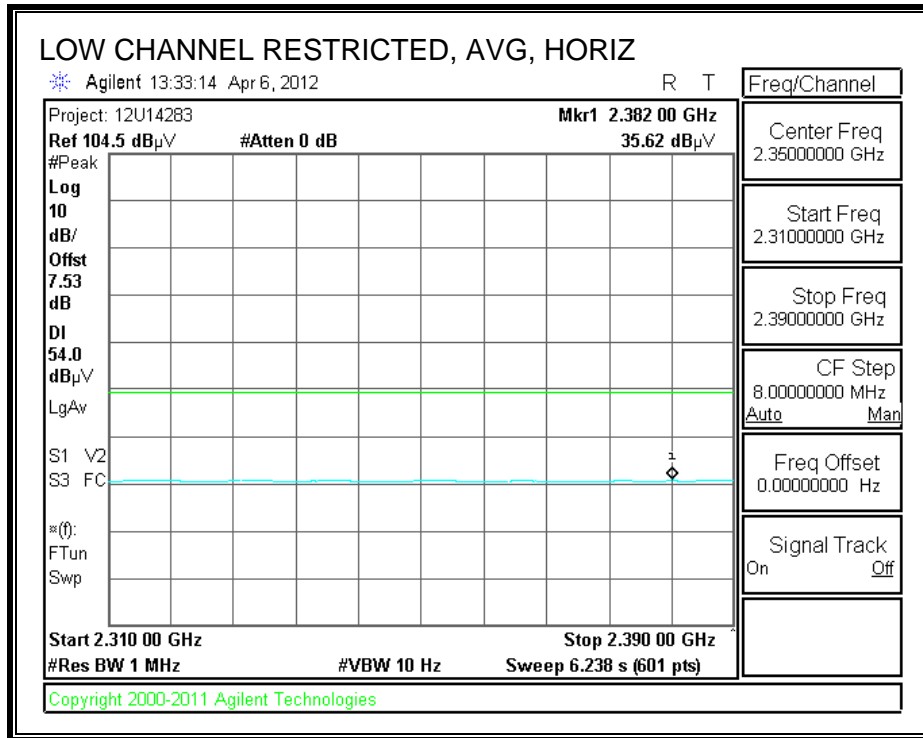
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

8.2. TRANSMITTER ABOVE 1 GHz

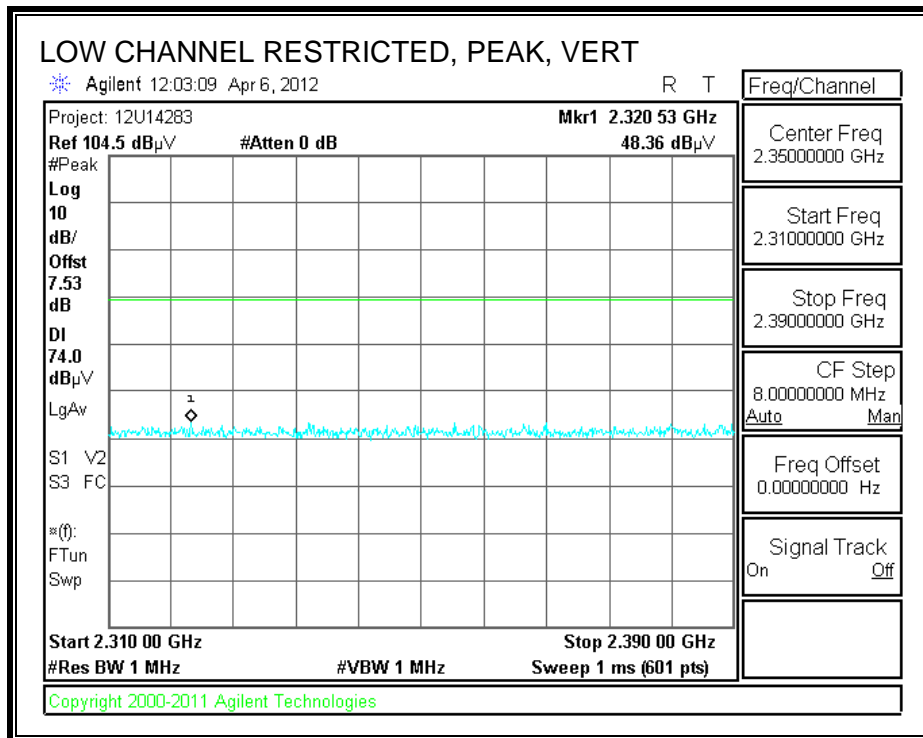
8.2.1. BASIC DATA RATE GFSK MODULATION

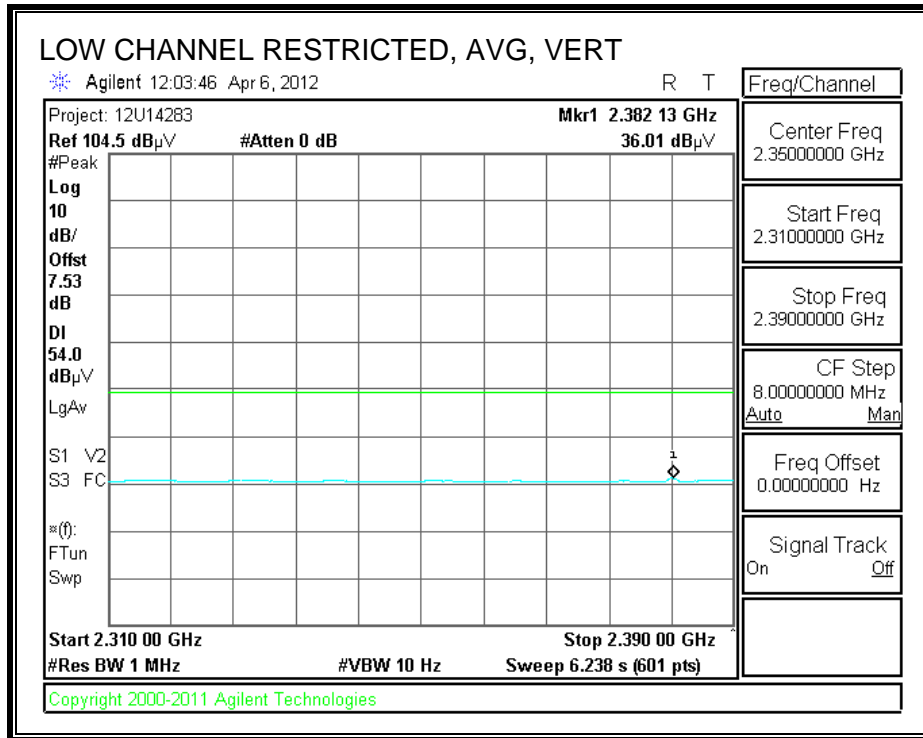
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



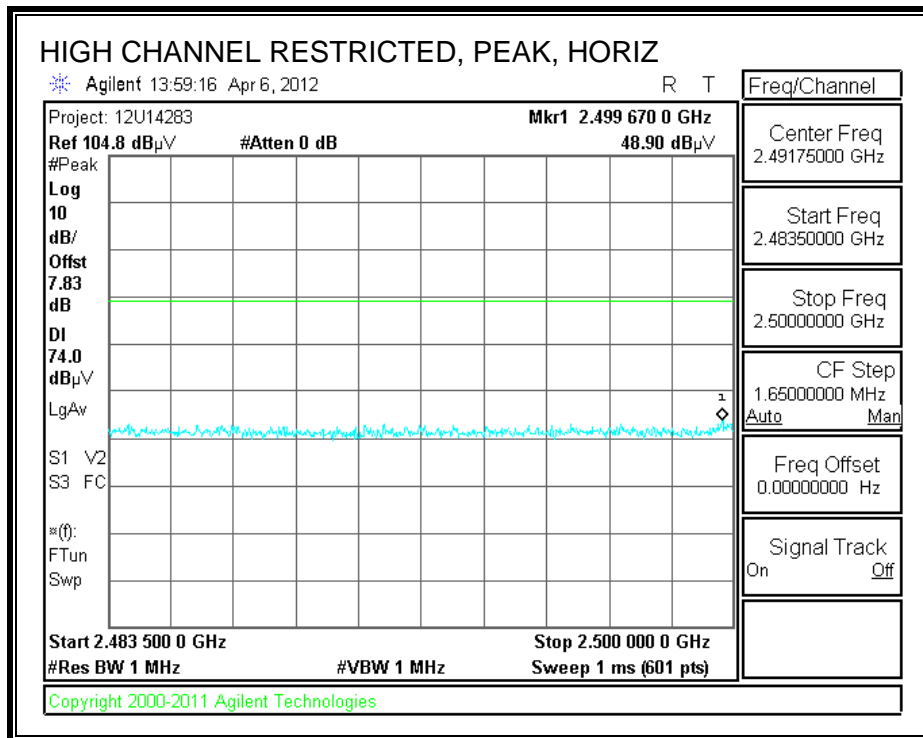


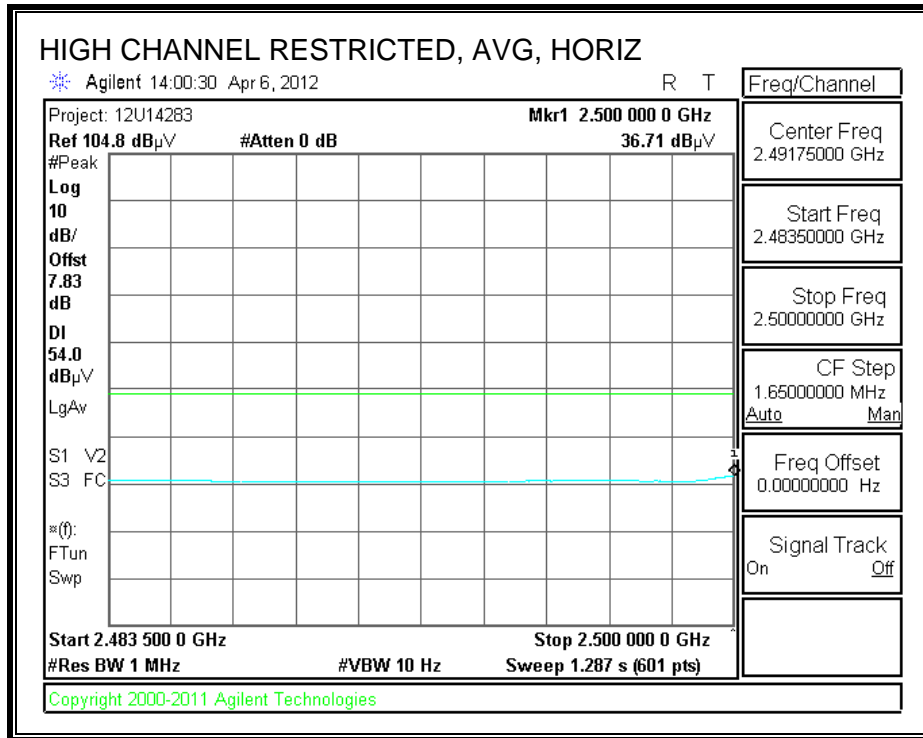
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



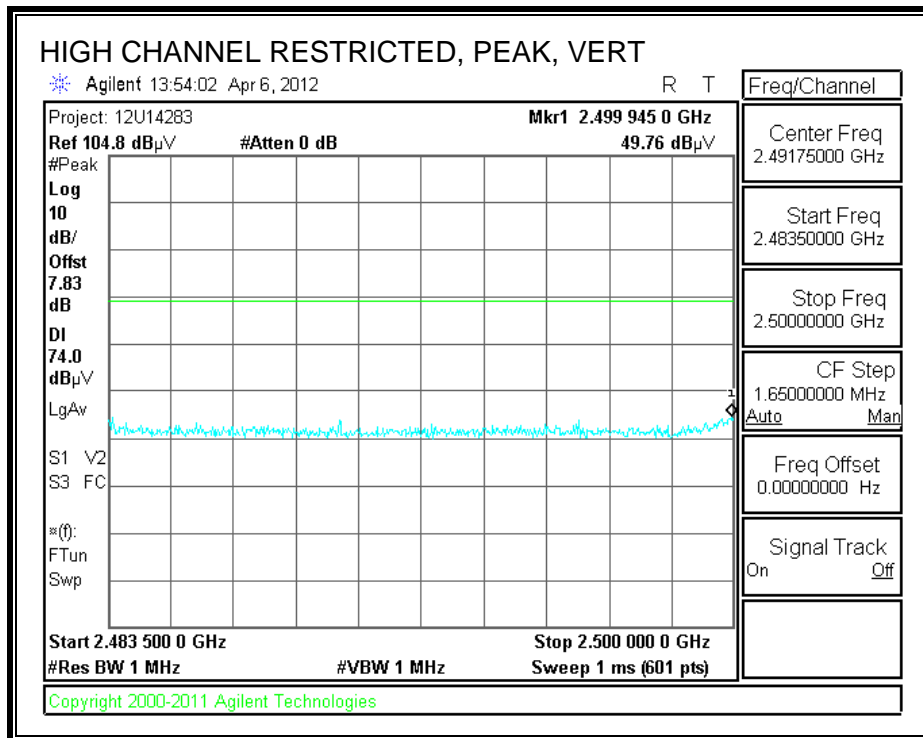


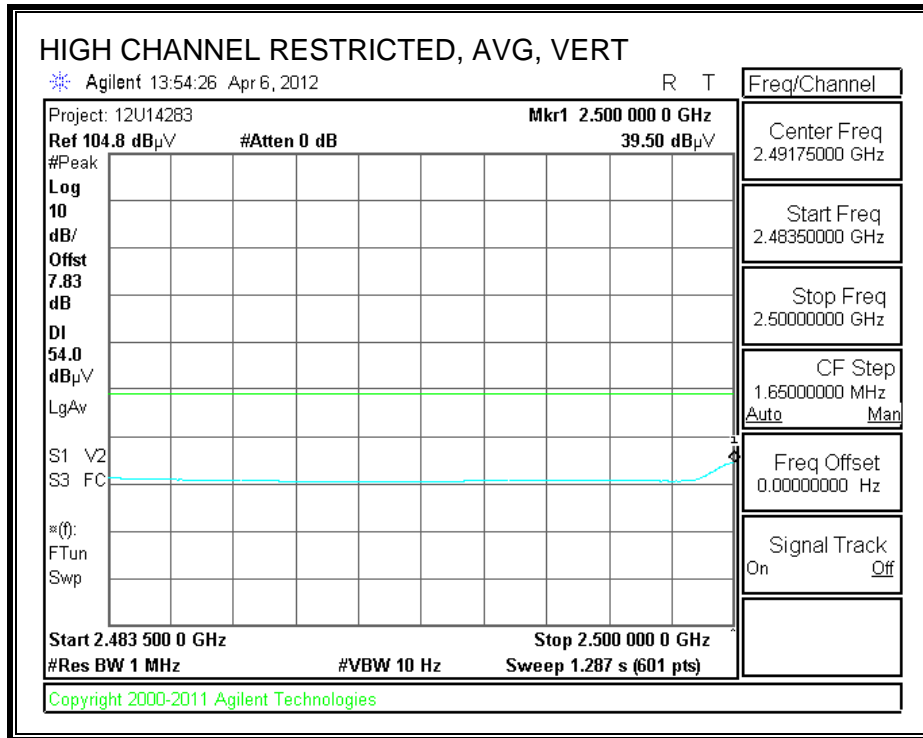
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)





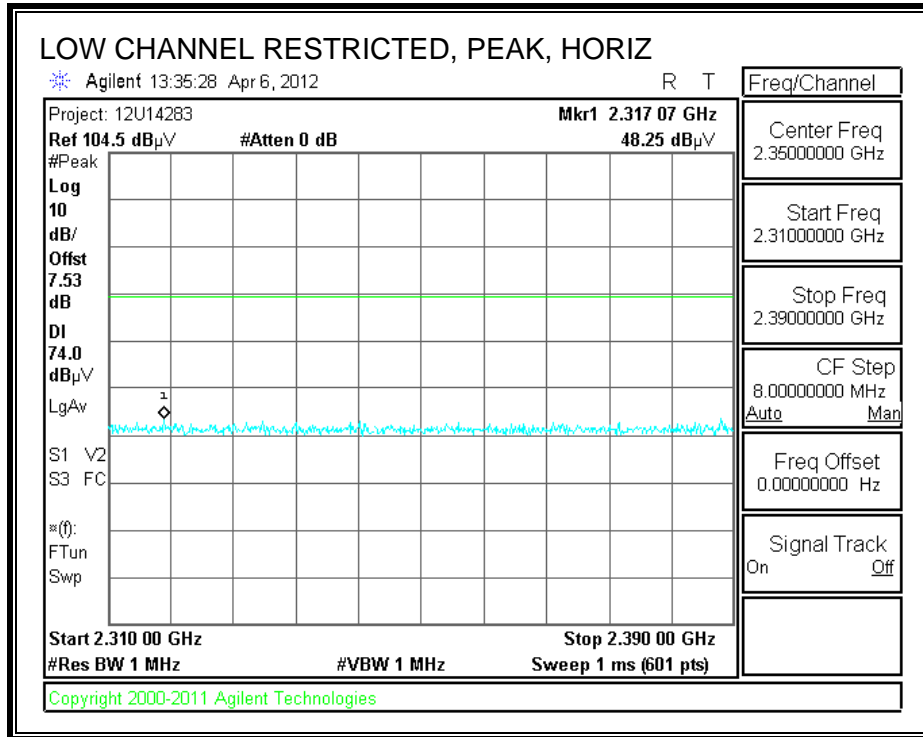
HARMONICS AND SPURIOUS EMISSIONS

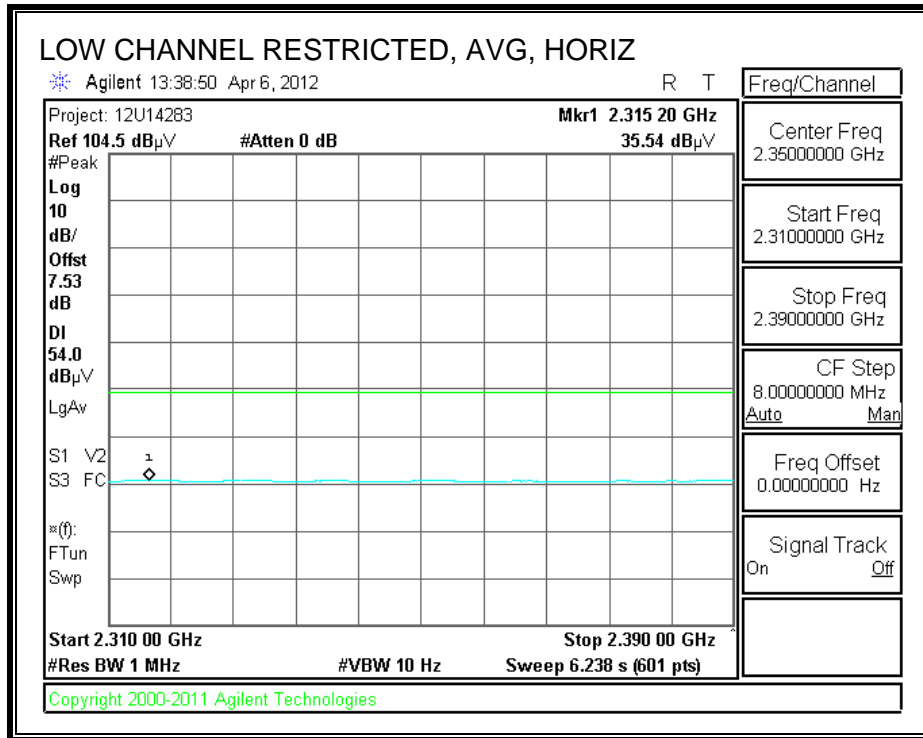
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Tom Chen											
Date:		04/06/12											
Project #:		12U14283											
Company:		Apple Inc											
Test Target:		FCC Class B											
Mode Oper:		Bluetooth GFSK mode, TX											
f	Measurement Frequency			Amp	Preamp Gain			Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter								
f	Dist	Read	AF	CL	Amp	D Corr	Fltr	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	
2402 MHz GFSK													
4.804	3.0	38.0	33.1	6.3	-34.8	0.0	0.0	42.6	74.0	-31.4	H	P	
4.804	3.0	25.6	33.1	6.3	-34.8	0.0	0.0	30.1	54.0	-23.9	H	A	
2402 MHz GFSK													
4.804	3.0	37.9	33.1	6.3	-34.8	0.0	0.0	42.4	74.0	-31.6	V	P	
4.804	3.0	25.7	33.1	6.3	-34.8	0.0	0.0	30.3	54.0	-23.7	V	A	
2441 MHz GFSK													
4.882	3.0	37.9	33.1	6.3	-34.8	0.0	0.0	42.5	74.0	-31.5	V	P	
4.882	3.0	25.3	33.1	6.3	-34.8	0.0	0.0	30.0	54.0	-24.0	V	A	
2441 MHz GFSK													
4.882	3.0	38.4	33.1	6.3	-34.8	0.0	0.0	43.0	74.0	-31.0	H	P	
4.882	3.0	25.4	33.1	6.3	-34.8	0.0	0.0	30.1	54.0	-23.9	H	A	
2480 MHz GFSK													
4.960	3.0	37.1	33.2	6.4	-34.8	0.0	0.0	41.9	74.0	-32.1	V	P	
4.960	3.0	25.3	33.2	6.4	-34.8	0.0	0.0	30.0	54.0	-24.0	V	A	
2480 MHz GFSK													
4.960	3.0	37.6	33.2	6.4	-34.8	0.0	0.0	42.3	74.0	-31.7	H	P	
4.960	3.0	25.2	33.2	6.4	-34.8	0.0	0.0	30.0	54.0	-24.0	H	A	

Rev. 4.1.2.7
 Note: No other emissions were detected above the system noise floor.

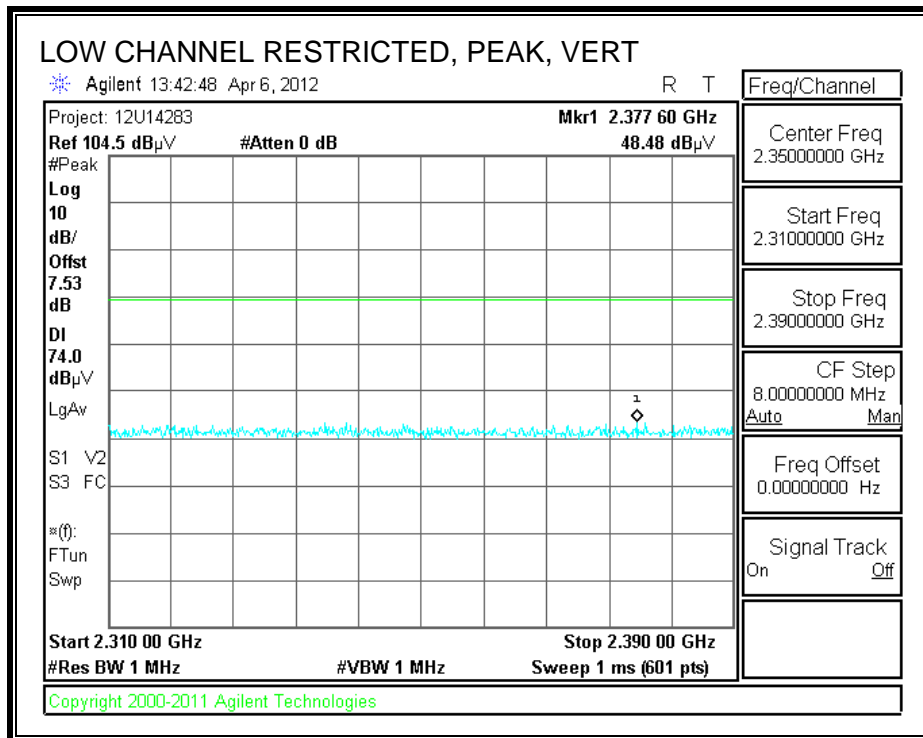
8.2.2. ENHANCED DATA RATE 8PSK MODULATION

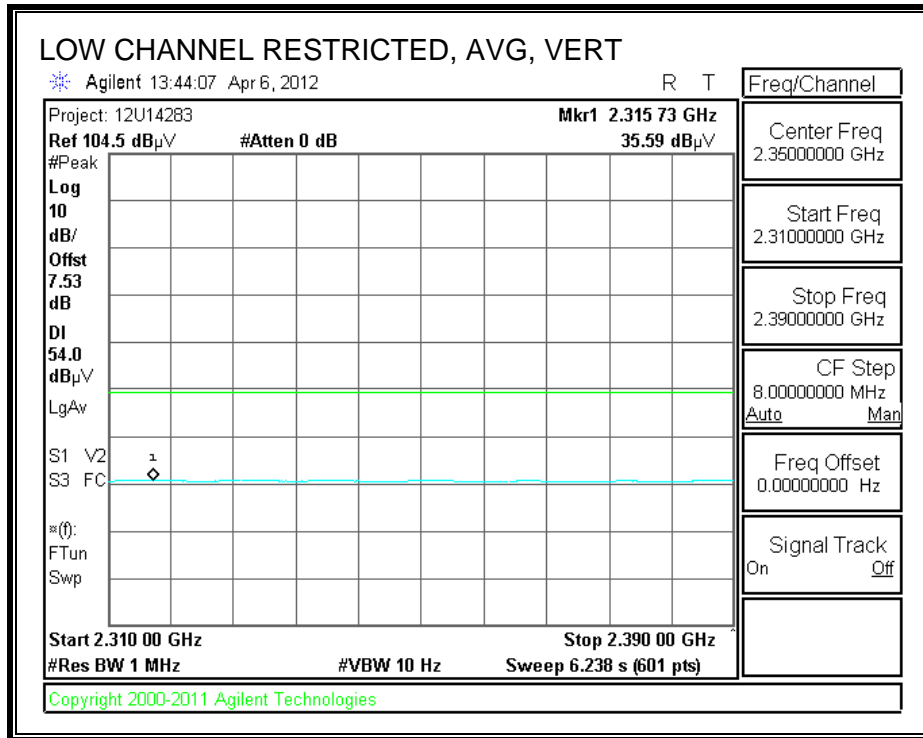
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



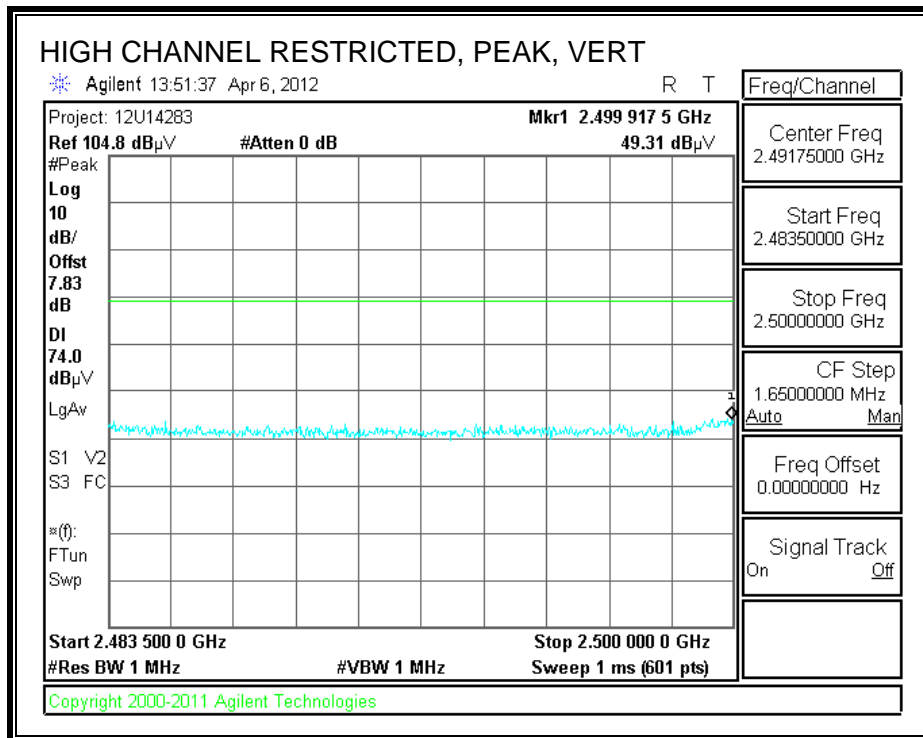


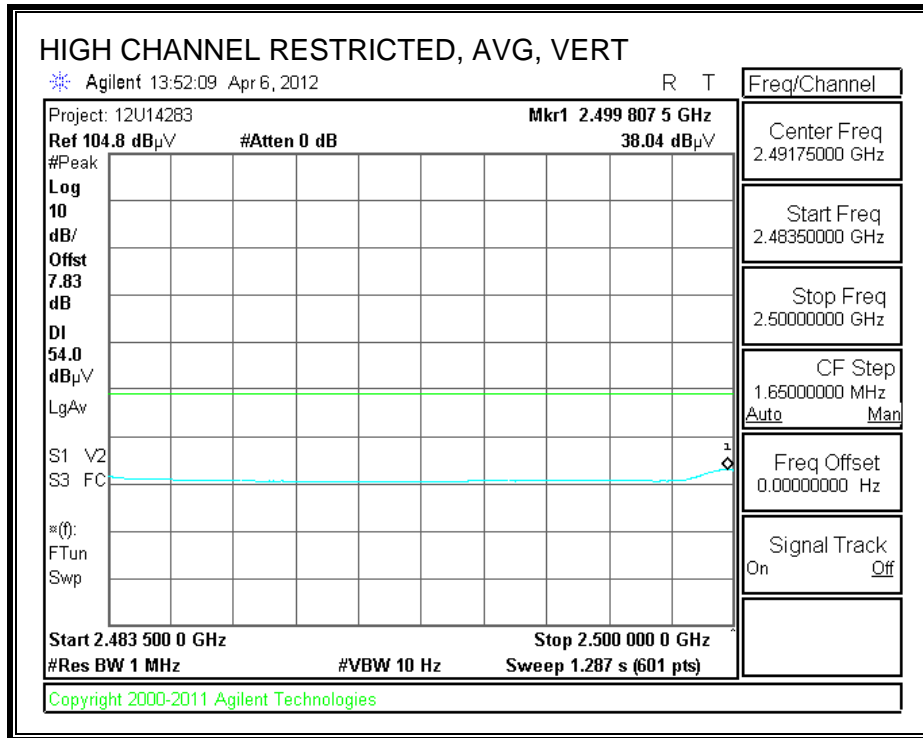
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Tom Chen											
Date:		04/06/12											
Project #:		12U14283											
Company:		Apple Inc											
Test Target:		FCC Class B											
Mode Oper:		Bluetooth 8PSK mode, TX											
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit									
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit									
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit									
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit									
CL	Cable Loss	HPF	High Pass Filter										
f	Dist	Read	AF	CL	Amp	D Corr	Fitr	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	
2402MHz													
4.804	3.0	38.6	33.1	6.3	-34.8	0.0	0.0	43.2	74.0	-30.8	H	P	
4.804	3.0	25.9	33.1	6.3	-34.8	0.0	0.0	30.4	54.0	-23.6	H	A	
2402MHz													
4.804	3.0	38.2	33.1	6.3	-34.8	0.0	0.0	42.7	74.0	-31.3	V	P	
4.804	3.0	25.9	33.1	6.3	-34.8	0.0	0.0	30.4	54.0	-23.6	V	A	
2441MHz													
4.882	3.0	37.7	33.1	6.3	-34.8	0.0	0.0	42.3	74.0	-31.7	V	P	
4.882	3.0	25.5	33.1	6.3	-34.8	0.0	0.0	30.1	54.0	-23.9	V	A	
2441MHz													
4.882	3.0	37.3	33.1	6.3	-34.8	0.0	0.0	42.0	74.0	-32.0	H	P	
4.882	3.0	25.4	33.1	6.3	-34.8	0.0	0.0	30.1	54.0	-23.9	H	A	
2480 MHz 8PSK													
4.960	3.0	37.9	33.2	6.4	-34.8	0.0	0.0	42.7	74.0	-31.3	H	P	
4.960	3.0	25.3	33.2	6.4	-34.8	0.0	0.0	30.0	54.0	-24.0	H	A	
2480 MHz 8PSK													
4.960	3.0	38.1	33.2	6.4	-34.8	0.0	0.0	42.9	74.0	-31.1	V	P	
4.960	3.0	25.3	33.2	6.4	-34.8	0.0	0.0	30.0	54.0	-24.0	V	A	

Rev. 4.1.2.7

Note: No other emissions were detected above the system noise floor.

8.3. RECEIVER ABOVE 1 GHz

High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber-B

Company: Apple Inc
 Project #: 12U14283
 Date: 04/06/2012
 Test Engineer: Tom Chen
 Configuration: EUT in Laptop
 Mode: RX mode

Test Equipment:

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T59; S/N: 3245 @3m	T145 Agilent 3008A0056			RX RSS 210

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz
3' cable 22807700	12' cable 22807600	20' cable 22807500			

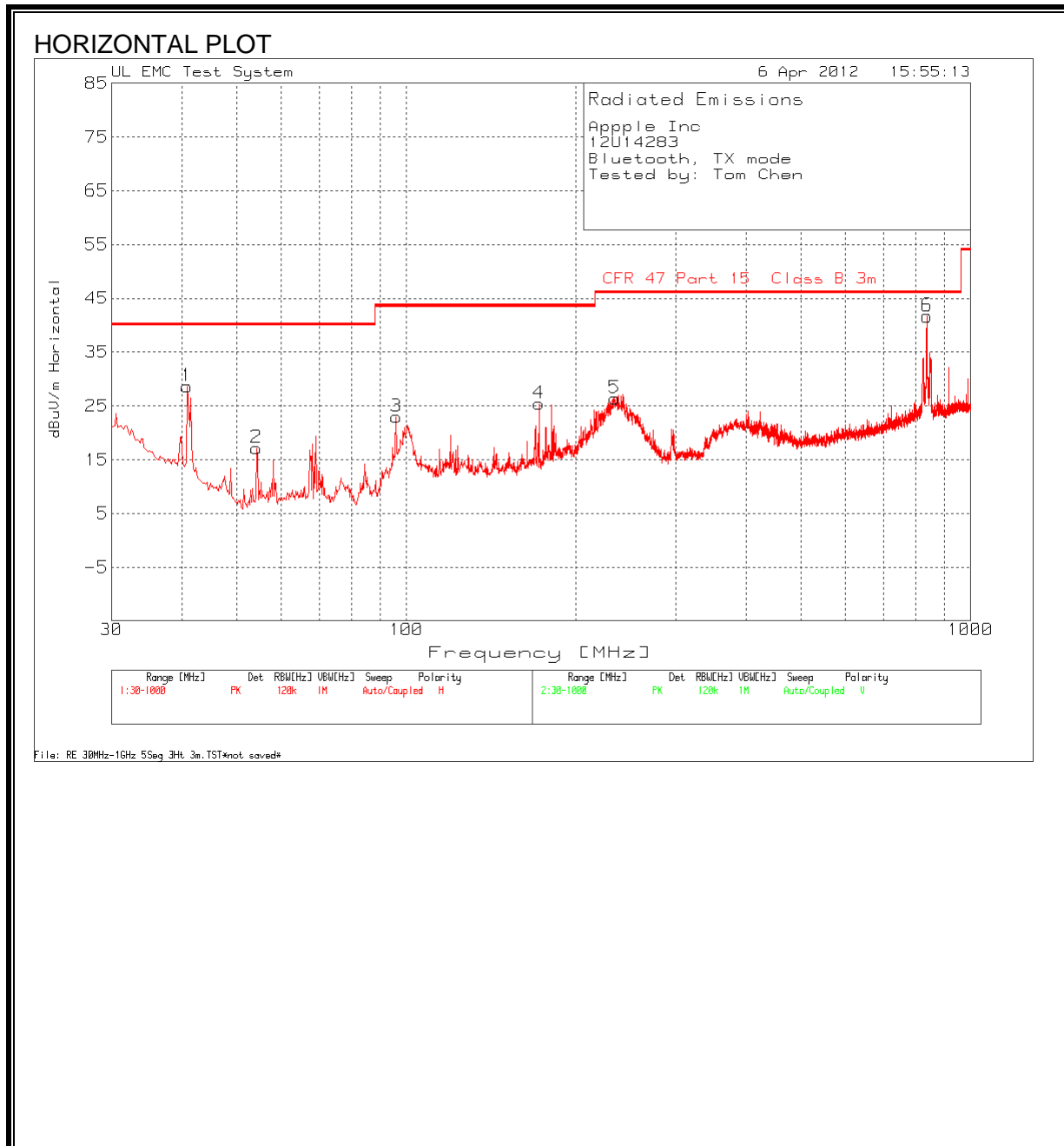
f	Dist	Read Pk	Read Avg.	AF	CL	Amp	D Corr	Fltr	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	(m)	dBuV	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	(V/H)
1.098	3.0	43.3	30.8	24.3	2.7	-35.9	0.0	0.0	34.4	21.9	74	54	-39.6	-32.1	H
1.857	3.0	41.5	29.5	27.7	3.6	-35.5	0.0	0.0	37.3	25.4	74	54	-36.7	-28.6	H
3.267	3.0	41.1	28.0	31.0	5.1	-35.1	0.0	0.0	42.1	28.9	74	54	-31.9	-25.1	H
1.098	3.0	43.5	30.9	24.3	2.7	-35.9	0.0	0.0	34.6	22.0	74	54	-39.4	-32.0	V
1.857	3.0	41.7	29.4	27.7	3.6	-35.5	0.0	0.0	37.5	25.3	74	54	-36.5	-28.7	V
3.267	3.0	40.0	28.0	31.0	5.1	-35.1	0.0	0.0	40.9	28.9	74	54	-33.1	-25.1	V

Rev. 07.08.11

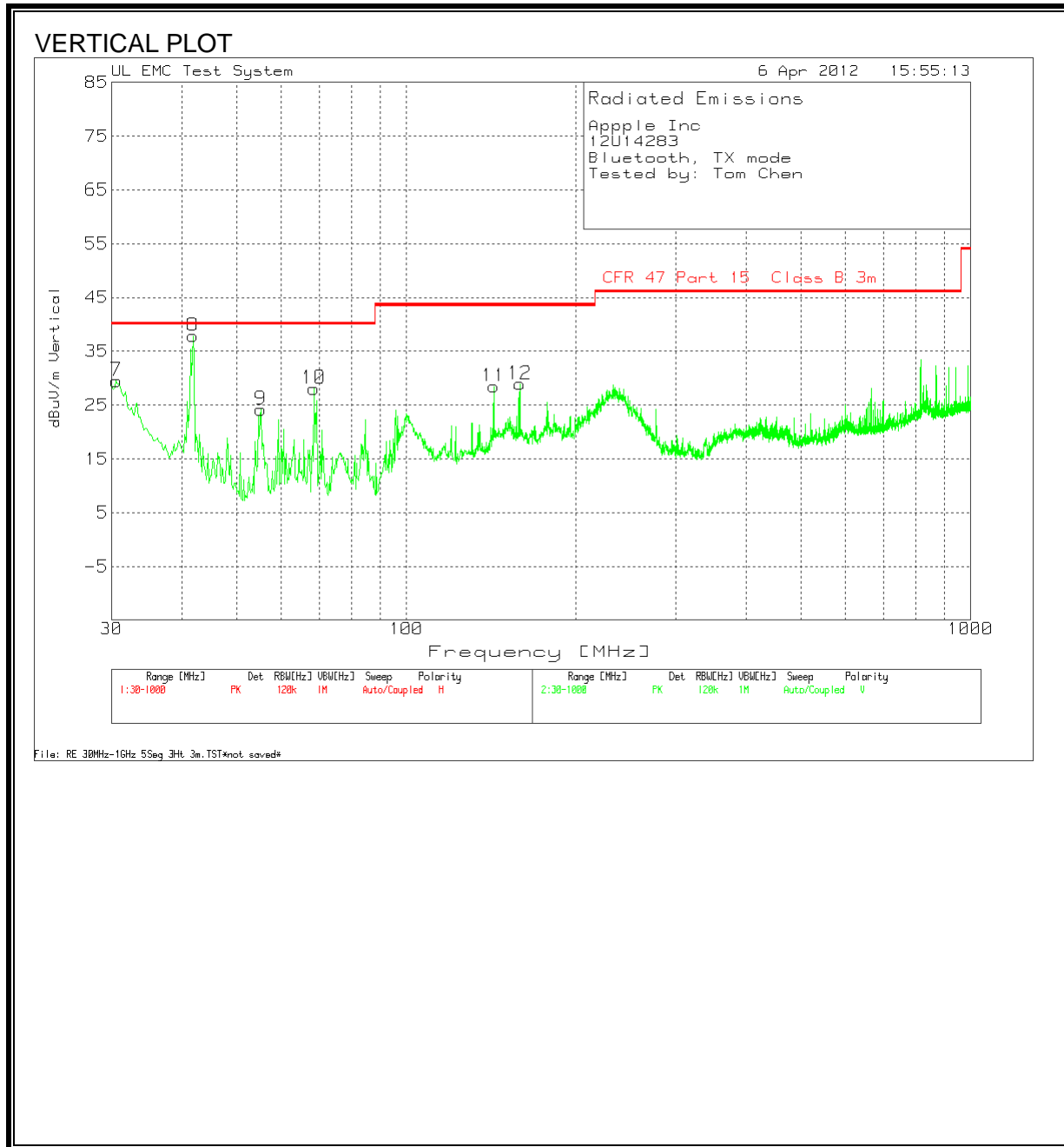
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

8.4. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)



SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)



HORIZONTAL AND VERTICAL DATA

Apple Inc							
12U14283							
Bluetooth, TX mode							
Tested by: Tom Chen							

Range 1 30 - 1000MHz

Test Frequency	Meter Reading	Detector	25MHz-1Ghz ChmbrB Amp [dB]	T130 Bilog Factors.TXT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin
40.8553	44.23	PK	-29.2	13.6	28.63	40	-11.37
54.2306	38.22	PK	-29	7.9	17.12	40	-22.88
95.9073	42.53	PK	-28.6	9	22.93	43.5	-20.57
171.7006	43.11	PK	-27.8	10.1	25.41	43.5	-18.09
233.731	41.79	PK	-27.3	11.9	26.39	46	-19.61
837.9456	45.67	PK	-25.2	21.2	41.67	46	-4.33

Range 2 30 - 1000MHz

Test Frequency	Meter Reading	Detector	25MHz-1Ghz ChmbrB Amp [dB]	T130 Bilog Factors.TXT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin
30.5815	38.72	PK	-29.3	20.1	29.52	40	-10.48
41.8245	54.07	PK	-29.2	13	37.87	40	-2.13
55.1998	45.25	PK	-29	7.9	24.15	40	-15.85
68.5751	48.72	PK	-28.9	8.2	28.02	40	-11.98
142.8177	43.58	PK	-28.1	13	28.48	43.5	-15.02
158.9069	45.81	PK	-27.9	11	28.91	43.5	-14.59

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

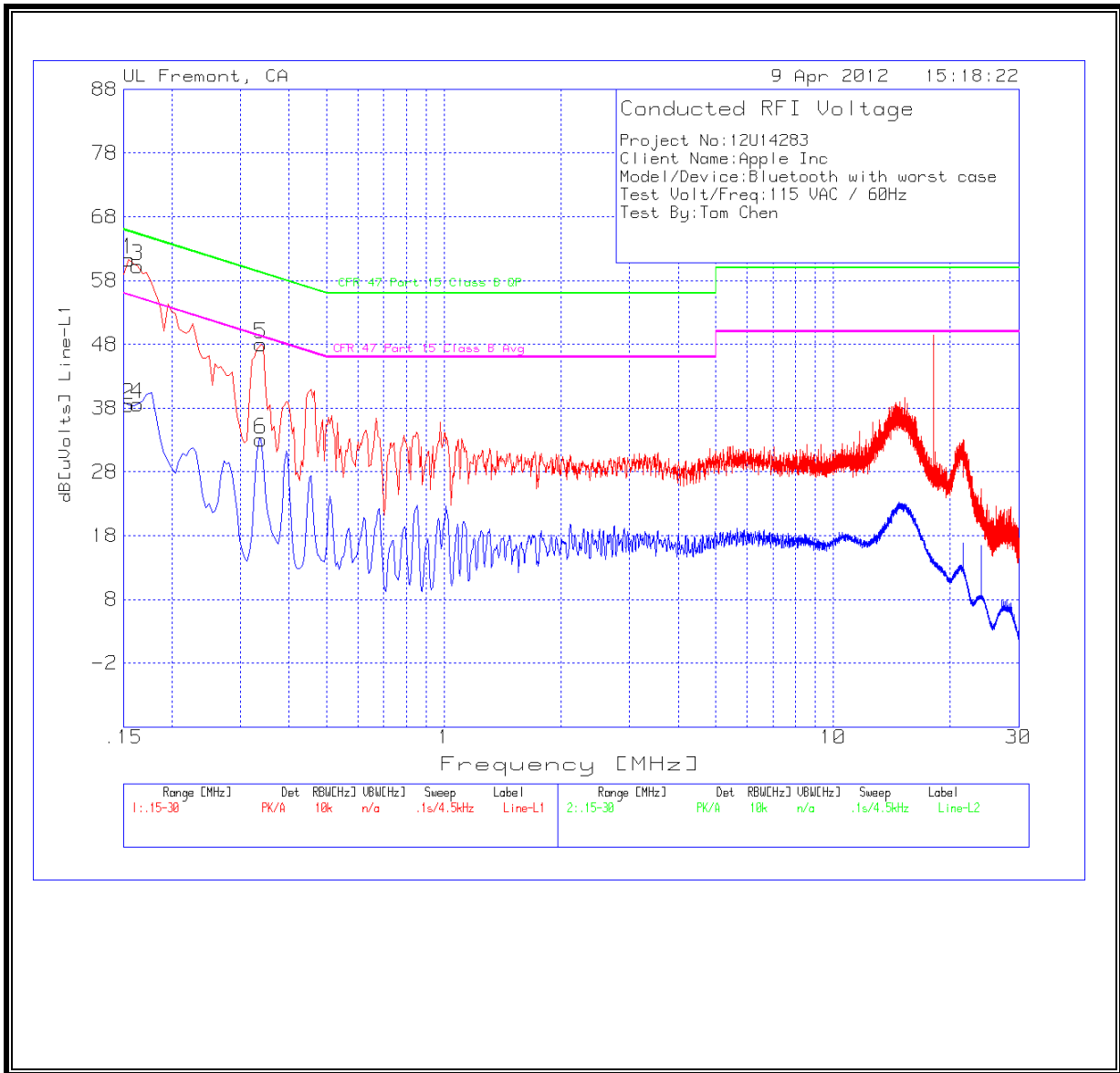
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

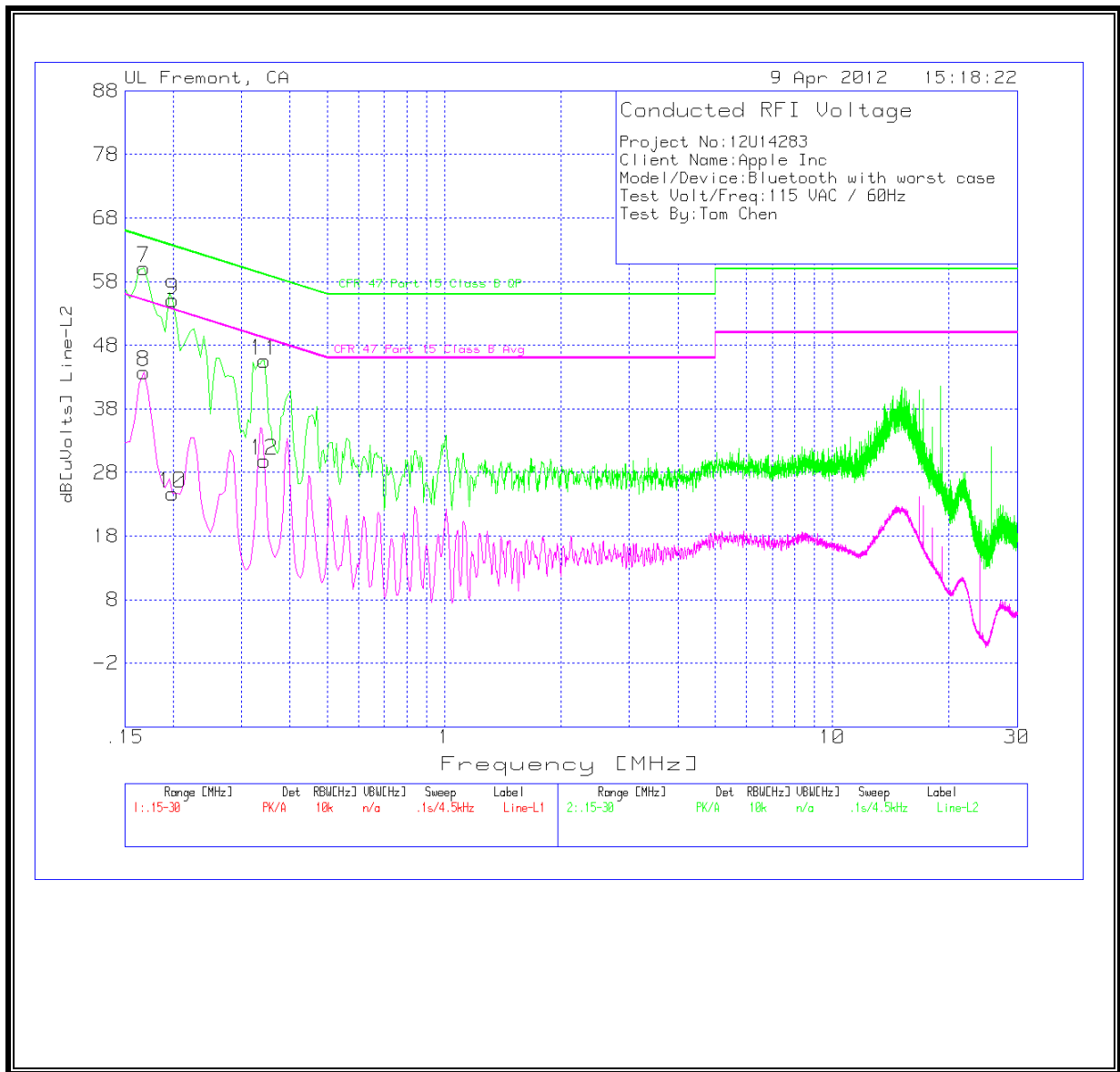
6 WORST EMISSIONS

Project No:12U14283									
Client Name:Apple Inc									
Model/Device:Bluetooth with worst case									
Test Volt/Freq:115 VAC / 60Hz									
Test By:Tom Chen									
Line-L1 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	T24 IL L1.TXT [dB]	LC Cables 1&3.TXT [dB]	dB[uVolts]	CFR 47 Part 15 Class B QP	Margin	CFR 47 Part 15 Class B Avg	Margin
0.1545	61.17	PK	0.1	0	61.27	65.8	-4.53	-	-
0.1545	38.4	Av	0.1	0	38.5	-	-	55.8	-17.3
0.1635	60.12	PK	0.1	0	60.22	65.3	-5.08	-	-
0.1635	38.57	Av	0.1	0	38.67	-	-	55.3	-16.63
0.339	47.88	PK	0.1	0	47.98	59.2	-11.22	-	-
0.339	32.92	Av	0.1	0	33.02	-	-	49.2	-16.18
Line-L2 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	T24 IL L2.TXT [dB]	LC Cables 2&3.TXT [dB]	dB[uVolts]	CFR 47 Part 15 Class B QP	Margin	CFR 47 Part 15 Class B Avg	Margin
0.168	60.09	PK	0.1	0	60.19	65.1	-4.91	-	-
0.168	43.73	Av	0.1	0	43.83	-	-	55.1	-11.27
0.1995	55.05	PK	0.1	0	55.15	63.6	-8.45	-	-
0.1995	24.55	Av	0.1	0	24.65	-	-	53.6	-28.95
0.3435	45.48	PK	0.1	0	45.58	59.1	-13.52	-	-
0.3435	29.7	Av	0.1	0	29.8	-	-	49.1	-19.3

LINE 1 RESULTS



LINE 2 RESULTS



10. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

**Table 5
 Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)**

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m ²)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> ^{1.2}
150 000–300 000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616 000 / <i>f</i> ^{1.2}

* Power density limit is applicable at frequencies greater than 100 MHz.

- Notes:**
1. Frequency, *f*, is in MHz.
 2. A power density of 10 W/m² is equivalent to 1 mW/cm².
 3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

EQUATIONS

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * \text{D}^2)$$

where

S = Power density in W/m²

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m² is converted to units of mW/cm² by dividing by 10.

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

where

D = Separation distance in m

EIRP = Equivalent Isotropic Radiated Power in W

S = Power density in W/m²

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

$$\text{Total EIRP} = (P1 * G1) + (P2 * G2) + \dots + (Pn * Gn)$$

where

Px = Power of transmitter x

Gx = Numeric gain of antenna x

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm²

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m²

RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m ²)	FCC Power Density (mW/cm ²)
2.4 GHz	Bluetooth	0.20	7.89	5.30	0.04	0.004